MEDICAL PRACTICE

Hospital Topics

Pulmonary Thromboembolism Presenting as Asthma

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Summary

When a patient presents with wheezing, pulmonary embolism is not usually considered as a possible cause. However, undoubtedly bronchoconstriction can be caused by pulmonary emboli and occasionally wheezing may be so obvious as to suggest a diagnosis of bronchial asthma. Eleven cases are reported in which wheezing was attributable to recurrent pulmonary emboli and one in which it was a clamant feature after a single embolic incident.

Introduction

It has been known since 1944[1] that bronchospasm occurs after experimental thromboembolism in dogs. In 1967 Sasahara *et al.*[2] showed that bronchoconstriction was present in 85% of their patients with recent pulmonary emboli. Among 250 consecutive patients whom we investigated by pulmonary angiography and found to have acute pulmonary embolism, 11 had sufficient wheezing to have been considered at first to be suffering from bronchial asthma. The case of a further patient (case 1) who did not have angiography is also described. In all cases wheezing was a prominent symptom. We record the results of functional and clinical assessment in these patients and describe the clinical features in more detail in four of them to illustrate this little recognized manifestation of pulmonary thromboembolic disease. Some details of cases 1, 6, 9, and 10 have been reported previously.[3 4]

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Present Series

CASE 1

A man aged 64 developed bronchospasm as part of the presentation of acute pulmonary embolism. He was admitted to hospital after a mining accident in which he sustained fractured ribs and a haemothorax on the left side. On the 18th hospital day he had a swollen right calf. Radioactive fibrinogen scanning[5] of the limbs confirmed the presence of a venous thrombosis in the right calf. Further confirmation of the extent of the thrombus was sought by means of ultrasound.[6] This requires the sudden application of pressure to the calf using either the hand or, as in this instance, a pneumatic cuff. During this manoeuvre he became suddenly breathless and hypotensive. After the hypotensive episode he had intense bronchospasm localized to the right side of his chest and had signs of acute right heart failure. Chest *x*-ray film showed a raised right hemidiaphragm, which had not been present previously, and the resolving left haemothorax. As the clinical features left no doubt that he had sustained a major pulmonary embolus no further investigation was undertaken. He was treated with anticoagulants and recovered.

The following patients had wheezing as their major symptom, so that at first they were thought to be suffering from bronchial asthma. The main investigation results in these and the remaining seven patients are summarized in the table.

CASE 2

This 64-year-old man suddenly became breathless with wheezing in 1964. His symptoms rapidly settled after a short course of prednisolone. Over the next seven years he had several episodes of wheezing severe enough to require corticosteroid therapy. In August 1971 he again had a severe attack of wheezing. This time it did not respond to conventional therapy at home and he was admitted to hospital. Intensive treatment eventually controlled his symptoms. Shortly after this stay in hospital he noticed that his left leg was beginning to swell. One week after discharge he had a further severe episode of wheezing of sudden onset and he was transferred to our care.

He had obvious cyanosis and severe bronchospasm. The jugular venous pressure was not increased, so that the asymetrical swelling of the legs was probably related to venous thrombosis. The arterial partial pressure of oxygen (Pao_2) was 43 mm Hg and of carbon

Clinical Data on Patients in Series

Case No.	Age (Years)	Age at Onset of Asthma (Years)	Pao_2 (mmHg)	$Paco_2$ (mmHg)	FEV/FVC	Angiography		Pulmonary Artery Pressure (mm Hg)		Mean Pulmonary Wedge Pressure (mm Hg)	Allergic Diathesis†	Family History of Allergy	Venous Pathology‡	Predisposing Factors
						Grade 1*	Grade 2*	Syst./Diast.	Mean					
2	64	57	43	48	51%	+		32/10	20	5	0	0	+	Renal carcinoma
3	50	50	62	42	64%		+	42/22	25	18	+	0	0	Mitral valve disease. Immobility
4	39	37	68	36	57%		+	50/20			0	+	0	Oral contraceptive
5	52	37			55%	+		28/15	22	10	+	0	+	Caesarean section
6	42	32			57%		+	27/13	17		0	0	0	Pregnancy
7	57	57			70%		+	42/15	28	13	+	0	+	—
8	40	34			58%	+		23/10	14	10	+	0	+	—
9	43	41	64	39	46%		+	30/12	17	13	+	0	0	Ulcerative colitis[19]
10	59	56			65%		+	21/7	11	3	+	+	0	Cellulitis of leg
11	40	38	39	46	59%		+	29/14	20	12	0	0	0	Obesity
12	56	56	62	33	45%	+		28/12	17	5	0	0	0	Rheumatoid arthritis

*Grade 1 = Intravascular filling defects; appearance of cut-off vessels; avascular opacities. Grade 2 = Focal decreased flow; distorted vessels and crowded vessels; small vessel loss.
†Allergic diathesis = Type 1 cutaneous hypersensitivity; sputum or blood eosinophilia.
‡Including presence of varicose veins and clinical evidence of deep venous thrombosis.

dioxide ($Paco_2$) 48 mm Hg. In spite of the raised $Paco_2$ breathing 28% oxygen via a Ventimask did not cause a further rise—$Paco_2$ 47 mm Hg with Pao_2 58 mm Hg. Pulmonary angiography (fig. 1) showed many intra vascular filling defects, thus establishing the diagnosis of pulmonary embolism. The main pulmonary artery pressure was increased but the wedged pulmonary arteriolar pressure

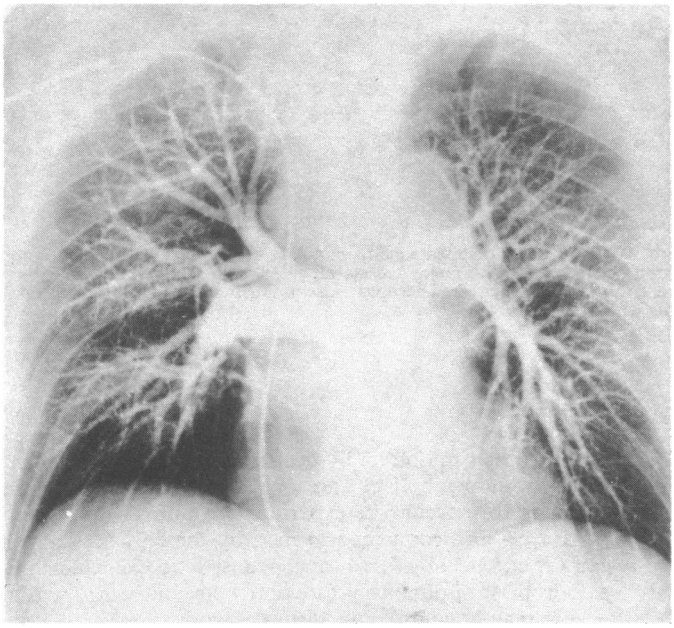

FIG. 1—Case 2. Angiogram showing filling defects partially occluding flow of contrast material in left main pulmonary artery and in medial branch of right lower pulmonary artery.

(representing left atrial pressure) was normal. He was treated with a continuous intravenous infusion of heparin and his wheezing gradually diminished. His angiogram one week after treatment showed great improvement. While in hospital and receiving anticoagulants he developed a retroperitoneal haematoma and died. At necropsy widespread pulmonary emboli, extensive left-sided thrombosis of the leg veins, and a right renal carcinoma were found. Histological examination of the lungs showed that the bronchial mucosa contained many eosinophils and an increased number of goblet cells. This appearance is a common finding in the lungs of asthmatic persons.[7] There was no personal or family history of an allergic diathesis.

CASE 3

A 50-year-old woman with mitral valve disease started to wheeze for the first time in March 1971. The wheezing began suddenly after a period of immobility lasting several hours. She was admitted to hospital with what appeared to the admitting physician to be status asthmaticus. Intravenous aminophylline, inhaled isoprenaline, and hydrocortisone failed to produce any improvement.

The possibility of pulmonary embolism accounting for her symptoms was then considered. The pressure in the main pulmonary artery was 42/22 mm Hg and that recorded from a wedged position was 18 mm Hg (mean). These increased pressures could have been the result of her mitral valve disease. Pulmonary angiography (fig. 2) showed abnormalities in keeping with the effects of pulmonary emboli.

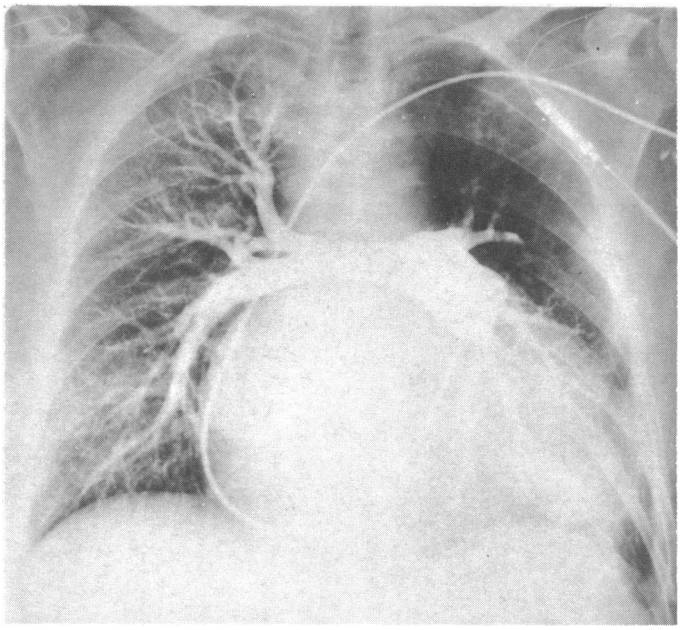

FIG. 2—Case 3. Angiogram before administration of anticoagulants. Vessels at left upper zone were slow to fill with contrast material and many large vessels did not fill out at all.

The major vessels at the left upper zone filled with contrast material very slowly and many vessels did not fill out at all. At the right lower zone the vessels were crowded together, and some appeared to end abruptly. She was treated with a continuous intravenous infusion of heparin and the previous medications were discontinued. On this regimen she improved and the bronchospasm lessened. Five days later the pressure in the main pulmonary artery had fallen to 35/20 mm Hg and the pulmonary angiogram showed that the vascular appearance had improved in both the left upper and right lower zones (fig. 3).

Intradermal skin testing showed Type 1 cutaneous hypersensitivity. There was no evidence of eosinophils in the sputum and no peripheral blood eosinophilia.

CASE 4

This patient developed wheezing for the first time at the age of 37 years. She had been well apart from occasional chest infections until she started taking an oral contraceptive preparation. Soon after

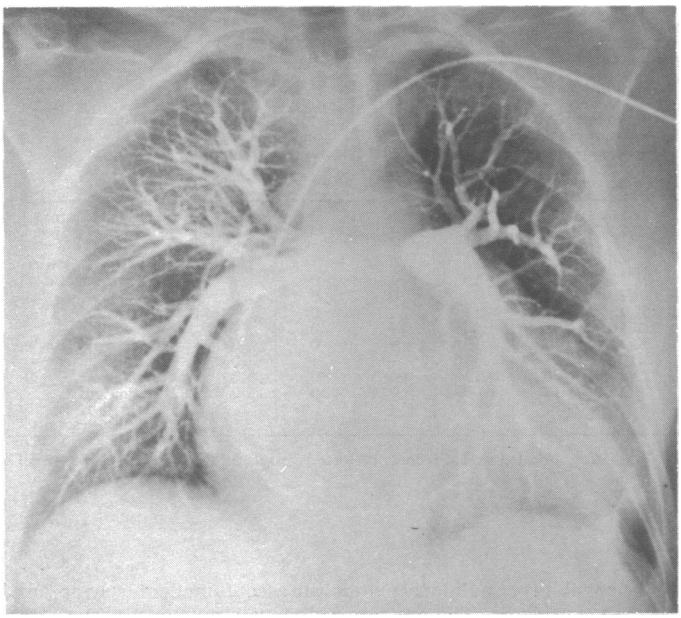

FIG. 3—Case 3. Angiogram after five days of anticoagulant therapy showing noticeable improvement in filling of large vessels at left upper zone.

starting this therapy she experienced the sudden onset of dyspnoea associated with wheezing.

There was clinical and electrocardiographic evidence of right heart strain. The main pulmonary artery pressure was 50/20 mm Hg. The pulmonary angiogram showed the features of pulmonary thromboembolism in the right lower zone (fig. 4). The electrocardiographic evidence of right heart strain regressed as did her symptoms of asthma after starting treatment with oral anticoagulants. No evidence of an allergic diathesis was shown although she had a daughter with allergic bronchial asthma.

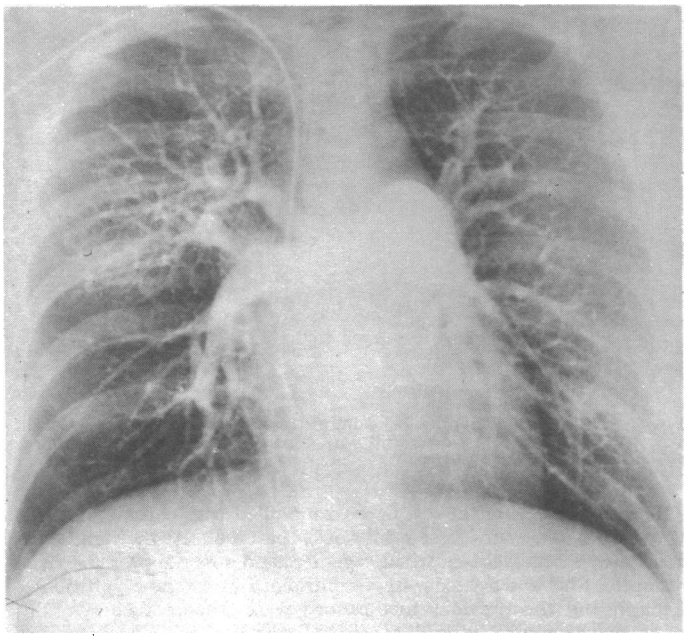

FIG. 4—Case 4. Angiogram showing large proximal pulmonary arteries and decrease in number of large and small vessels at right lower zone compared with other regions.

Other Studies

In addition to the cases presented above and in the table we have studied six patients with asthma in whom we concluded after all investigations including pulmonary angiography that pulmonary emboli were not present and therefore were not contributing to the patient's symptoms. All six had evidence of an allergic diathesis. Three patients had a minor increase of the pulmonary artery pressure. The pulmonary angiograms from these patients showed no grade 1 evidence of embolism—that is, there were no intravascular filling defects, no appearance of cut-off vessels, and all the major vessels were present. Two of the angiograms were normal while the remaining four showed small vessel loss with the major pulmonary arteries appearing thin and attenuated (fig. 5). This latter appearance is that of pulmonary hyperinflation probably with emphysema. These abnormalities were different from those already described in the cases of pulmonary emboli.

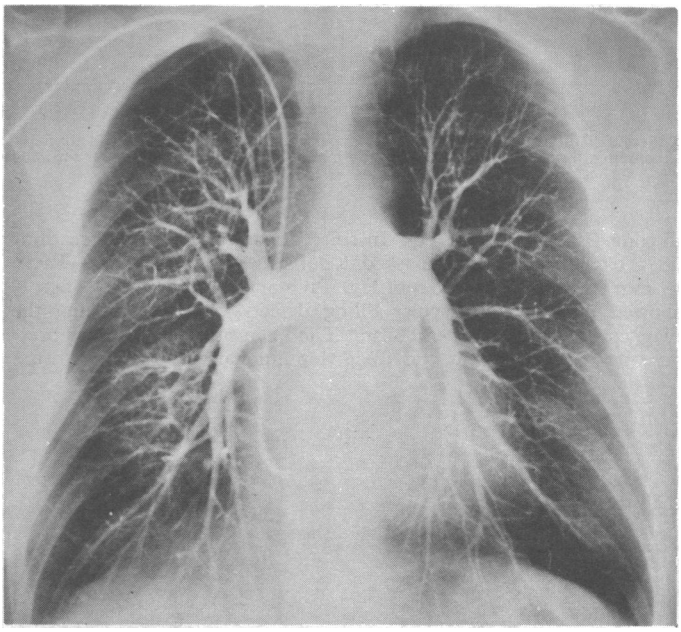

FIG. 5—Angiographic appearance from a case of bronchial asthma without thromboembolism. The major vessels all filled with contrast material but were thin and attenuated. There was loss of small vessel pattern. Contrast this with figs. 2 and 4.

Discussion

Bronchoconstriction undoubtedly occurs after most episodes of pulmonary thromboembolism and case 1 is a rather dramatic example. That this occurs in experimental animals has been shown by Boyer[1] and confirmed in man by the clinical studies of Sasahara *et al.*[2] Usually this bronchoconstriction is detectable only by appropriate pulmonary function tests, but occasionally the wheezing may be audible on clinical examination.

The first case with "embolic-induced asthma" diagnosed during life was reported by Gurewich *et al.*[8] They described a previously fit athletic young woman with severe airways obstruction in the seventh month of pregnancy. Since there was no apparent cause for her bronchoconstriction pulmonary embolism was considered and she was treated empirically with heparin. There was a short but dramatic improvement in her condition while receiving heparin. She died, however, soon after the start of treatment. At necropsy the presence of pulmonary microemboli were shown with no stigmata of airways disease. These authors also described a further case with what appeared to be characteristic intrinsic asthma, but at necropsy the only abnormality found was pulmonary emboli of varying ages. In 1962 Emery[9] described the case of a child of 16 months with status asthmaticus. The child did not respond to adequate conventional therapy for this condition and died. At necropsy widespread pulmonary thromboemboli were found. There was no evidence of asthma or airways disease.

Webster *et al.*[10] described the cases of three patients with pulmonary emboli in whom wheezing was a prominent feature in the clinical presentation. The diagnosis of pulmonary em-

bolism was made apparent in these cases by the other suggestive clinical signs and by lung scanning.

Occasionally the wheezing is so pronounced that bronchial asthma is the initial diagnosis, and it is only after appropriate investigation that the true nature of the abnormality becomes obvious. Olazabal *et al.*[11] described three patients who were treated initially for bronchial asthma as wheezing was their major symptom. Each, however, had some feature in the clinical history to suggest pulmonary thromboembolism, and investigation by means of angiography established the diagnosis.

In the present series of 11 patients wheezing was the main feature of the clinical presentation, and in one case it was a striking clinical feature. After investigation we concluded that pulmonary thromboemboli were playing at least a part in the aetiology of the bronchoconstriction and may well have been doing so for a long time—for example, case 2. Six patients had evidence of an allergic diathesis—either type 1 cutaneous hypersensitivity or the presence of sputum or blood eosinophilia. In all 11 patients the asthma had started relatively late in life (see table). Six had pulmonary hypertension. In one patient this was probably related to the presence of mitral valve disease, but in the others the raised main pulmonary artery pressure was not associated with a raised indirect left atrial (wedged) pressure. In three other patients the main pulmonary artery pressure was just outside the normal range.

The diagnosis of pulmonary embolism was made in all cases, except case 1, after pulmonary angiography. The interpretation of vascular abnormalities in the presence of airways obstruction may be difficult. Various authors[12 13] have described abnormalities in blood flow distribution in asthma and other chronic obstructive airways disease. These abnormalities have usually been detected by radio isotope lung scanning. Bryant *et al.*[14] examined the blood flow patterns in chronic obstructive airways disease by radio isotope lung scanning and by pulmonary angiography. They found that the distribution of pulmonary blood flow was abnormal in all these diseases but that there was little correlation between the scan abnormalities and the pulmonary angiographic appearances. Our own experience is that there is often poor correlation between radio isotope lung scanning and pulmonary angiography in pulmonary thromboembolism, even when there is unequivocal angiographic evidence of thromboembolism. Pulmonary angiography is therefore the investigation of choice.

The presence of filling defects in major vessels firmly establishes the diagnosis of pulmonary embolism. This appearance was seen in only one of these patients (case 2). Nevertheless, in the routine investigation of patients suspected of having pulmonary emboli with or without wheezing the presence of filling defects is neither the only nor the most common abnormality seen on angiography. The presence of vessels which appear to end abruptly on angiogram films is good evidence of pulmonary embolism.[15] This evidence was present in two patients (cases 8 and 12). One patient (case 5) had an avascular opacity. The opacity was seen on the chest *x*-ray film but regressed and was a pulmonary infarction. In the remainder of the cases the diagnosis was based on slow filling and emptying of major vessels with loss of small vessel pattern. These latter appearances taken in isolation are not diagnostic of embolism but they did not occur in any case in which the accumulated evidence led to a diagnosis of asthma without embolism, nor in any case of emphysema that we have investigated. The improved appearance of the angiogram repeated after a period of treatment provided confirmatory evidence in several instances.

The angiograms shown in figs. 2 and 3 illustrate these latter points. The first was taken before treatment with anticoagulants. It shows that the vasculature in the left upper zone was very abnormal. Several major arteries did not fill out with contrast material. At the right lower zone the vessels were crowded together. This appearance is non-specific but it occurs in patients with undoubted pulmonary emboli. This patient's clinical improvement after starting treatment with anticoagulants suggested that pulmonary embolus was the correct diagnosis. The second angiogram (fig. 3) was taken after only five days of treatment. The patient was still wheezing although the degree of airways obstruction had lessened. The angiogram showed marked improvement in both left upper and right lower zones. This patient subsequently returned to our care with an incident of pleuritic chest pain, haemoptysis, and opacities on the chest *x*-ray film which left no doubt that she had sustained a pulmonary embolus. At that time wheezing was again a troublesome symptom.

The relationship of bronchial constriction to pulmonary thromboembolism is well established, but the mechanism by which the bronchoconstriction is caused is not certain. In experimental work in dogs it seems certain that the bronchoconstriction is related to the release of serotonin from platelets on the clot.[16] The release of serotonin can be prevented by the administration of intravenous heparin, and this prevents the development of bronchoconstriction.[16] The administration of heparin to patients with embolic-induced asthma reduces the bronchoconstriction. We were able to show this response to heparin (in contrast to placebo) in case 9. This effect, however, may be non-specific and of little diagnostic value. Boyle *et al.*[17] studied the effect of intravenous heparin on airways obstruction due to a variety of conditions and found that the bronchoconstriction was reduced in a significant number of these. This was not confirmed by Gurewich *et al.*,[8] however, who found that the bronchoconstriction related to bronchitis and emphysema was not relieved by intravenous heparin. It has been suggested that human bronchial musculature is not sufficiently sensitive to serotonin to account for any bronchoconstriction occurring by this mechanism.

After any pulmonary vascular occlusion the partial pressure of carbon dioxide in the affected alveoli will decrease.[18] The low $Paco_2$ causes bronchoconstriction in the affected areas in experimental animals.

It is interesting that half of the present patients with asthmatic symptoms and pulmonary embolism had evidence of an allergic diathesis. It seems likely, therefore, that this group of patients, who have abnormally reactive bronchi, may respond to some factor related to pulmonary emboli by bronchial constriction.

To decide that a patient's wheezing is related to a pulmonary embolus may be difficult. In any one patient different factors may be responsible for the wheezing on separate occasions. We suggest that the following features may be a pointer to the presence of pulmonary embolism as a factor in wheezing.

(*a*) Any clinical feature suggestive of pulmonary embolism, especially right heart failure, venous abnormalities in the lower limbs, or haemoptysis. Chest *x*-ray and electrocardiographic abnormalities can occur both in bronchial asthma and after pulmonary embolism. The presence of electrocardiographic evidence of right heart strain, however, should suggest the possibility of pulmonary embolism. (*b*) Associated conditions known to predispose to the occurrence of pulmonary emboli—for example, pregnancy, surgical operations, or the administration of oral contraceptives. (*c*) Failure to respond in the usual fashion to adequate conventional therapy for bronchial asthma. (*d*) Wheezing that has started relatively late in life.

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Contemporary Themes

Whither Psychiatric Day Care? A Study of Day Patients in Birmingham

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Summary

A survey was made of the 647 patients attending the seven psychiatric day hospitals in Birmingham during a single census week, and of their patterns of attendance in day-care over the following 12 months. Marked differences were found between the day patients (583) attending the four large, traditional hospitals, and those (64) attending three small, relatively modern units. Patients attending the large hospitals were older, included the majority of schizophrenics, and carried a greater morbidity as measured by the frequency and duration of previous psychiatric care. At the end of the follow-up period 64% of patients attending the large hospitals were still in day care as against only 2 patients attending small hospital units.

It is suggested that the results have important implications for the planning of future mental health services in that they highlight the extent to which different groups of patients have different requirements. A large proportion of the day hospital population had long-term needs which might be difficult to meet in the proposed general hospital units.

Introduction

There has been strong opposition to the "guide lines" put forward by the Department of Health and Social Security[1] for the provision of psychiatric services after the unification of the National Health Service in 1974. The Department proposes that the existing mental hospitals should be run down and eventually closed and that all beds for the mentally ill should be provided in the psychiatric departments of district general hospitals on a ratio of 0·5 per 1,000 population.* This policy has been sharply criticized in a report of the Tripartite Committee on the Mental Health Service after Unification.[2] The Committee maintains that the case for providing all psychiatric beds in district general hospitals is far from established on the grounds that not only will the numbers be inadequate for a high quality service but also that the facilities will be quite unsuited to the needs of certain categories of patients, such as the psychogeriatric and the younger long-term disabled.

The Department's policy presupposes that the eventual provision of community care will be so successful that the existing mental hospitals will not be needed. Criticizing this as an unwarranted assumption, the Tripartite Committee warns against an over-optimistic appraisal of what community care can achieve —"Community care has been the popular slogan for the past decade. Indeed the operation of a system of community care is seen by some enthusiasts almost as a panacea, even as a 'cure' for chronic schizophrenia." But, the Committee emphasizes, the development of this mode of care has been uneven and decisions have been taken based more on intuition than on knowledge, research, and experience. As community care develops "so must it be evaluated, and it is our opinion that only when it is a proved success will it be prudent to plan for curtailing or abolishing existing facilities," a conclusion strongly supported in the *British Medical Journal*.[3]

One of the basic elements in the concept of community care is psychiatric day care. In the United Kingdom the first psychiatric day hospital was established in 1946 and received with some scepticism.[4] Interest gradually increased and by 1959 there were at least 39 psychiatric day hospitals.[5] In the early 1960s a drive to reduce the number of inpatient beds in mental hospitals led to a proliferation of day hospitals. At the present time large numbers of people throughout the country are enrolled as psychiatric day patients.

In planning for the future the Department of Health and Social Security anticipates that wherever possible a day hospital will form an integral part of the total service in the psychiatric departments of district general hospitals. The facilities provided for patients' activities of all kinds (social, industrial,

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* There is at present 0·7 bed per 1,000 population available for patients with a duration of stay under one year and 1·78 for those staying over one year.